

INTRAVENOUS PHOSPHATE REPLACEMENT RECOMMENDATIONS FOR PATIENTS WITH NORMAL RENAL FUNCTION

Intravenous Phosphate Replacement for Patients NOT receiving Parenteral Nutrition

Serum Phosphate Level (mg/dL)	mmol of Phosphate
2 to 3	10 mmol
< 2	15 mmol

- Dilute in 150 ml 0.9% NaCl or D5W and infuse over 6 hours.
- If the patient's potassium is < 3.9, administer as potassium phosphate (contains 3 mmol/mL of phosphate and 4.4 mEq/mL of potassium).
- If the patient's potassium is > 3.9, administer as sodium phosphate (contains 3 mmol/mL of phosphate and 4 mEq/mL of sodium).
- Repeat phosphate level 6 hours after completion of infusion. Repeat doses based on levels.
- Guidelines are intended for patients with normal renal function. Decreased dosage, and more frequent monitoring is advised in patients with renal insufficiency.
- Monitor: Chem-7, ICa, and Magnesium.

Intravenous Phosphate Replacement for Patients receiving Parenteral Nutrition

Serum Phosphate Level (mg/dL)	mmol/Kg of Phosphate	mmol dose for 70 Kg patient
2.5 to 3.4	0.16	11
1.6 to 2.4	0.32	22
<1.6	0.48	34

- Patients receiving specialized nutritional support have a higher demand for phosphorus, are prone to hypophosphatemia, and have serum phosphorus concentrations that may be more difficult to normalize. Mechanisms include intracellular shifts of phosphorus due to increased demands for the production of adenosine triphosphate needed for tissue anabolism, increased urine losses of phosphorus resulting from glucose-induced osmotic diuresis, administration of phosphorus-deficient parenteral nutrition, and poor intake before therapy resulting in partial or total body depletion. It may take 3 to 5 days for phosphate levels to normalize. Addition of phosphate to parenteral nutrition solutions may be limited secondary to compatibility constraints.
- Follow steps 1 through 6 above for administration guidelines.

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INTRAVENOUS CALCIUM REPLACEMENT RECOMMENDATIONS

Treatment of Non-symptomatic Hypocalcemia

Ionized Calcium (mg/dL)	Calcium Gluconate Dose	Infusion Rate
4 to 4.5	4.5 mEq (1 Gram)	Infuse over 30 minutes
3.6 to 3.9	9 mEq (2 Grams)	Infuse over 60 minutes
<3.5	13.5 mEq (3 Grams)	Infuse over 60 minutes

- Calcium gluconate 1 Gram = 4.5 mEq = 93 mg elemental calcium
- Dilute in 100 ml of 0.9% NaCl or D5W.
- Bolus doses of calcium only increase the serum-ionized calcium concentration for a short period of time and should be followed by repeated boluses or as an infusion if patient is symptomatic.
- Monitor: Chem-7, ICa, phosphate and magnesium levels.
- Use caution when repleting calcium in patients with *hyperphosphatemia* to avoid potential calcium/phosphate precipitate.

Emergency Treatment of Symptomatic Hypocalcemia

- Give 9 mEq (2 Grams) of Calcium gluconate in 100 ml of NaCl or D5W and infuse over at least 15 minutes.
- If symptoms of hypocalcemia persist or recur, follow with an infusion of 27 mEq (6 Grams) of calcium gluconate in 1 Liter 0.9% NaCl or D5W and infuse over 6 to 12 hours.

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INTRAVENOUS POTASSIUM REPLACEMENT RECOMMENDATIONS FOR PATIENTS WITH NORMAL RENAL FUNCTION

Serum potassium (mEq/L)	Recommended IV KCl supplementation	Recommended follow-up monitoring
3.5 - 3.9	20 mEq x1 dose	Recheck serum potassium in 2 hours and with a.m. labs
3 - 3.4	20 mEq x4 doses	Recheck serum potassium 2 hours after 4th dose and with a.m. labs
2.5 - 2.9	20 mEq x6 doses	Recheck serum potassium 2 hours after the 4 th dose then give 5 th and 6 th doses, if needed. Recheck in a.m.
2 - 2.4	20 mEq x8 doses	Recheck serum potassium and magnesium 2 hours after the 6 th dose then give 7 th and 8 th dose, if needed. Recheck in a.m. <i>Additional supplemental doses may be indicated.</i>

- These Guidelines are intended for patients with normal renal and adrenal function.
- Caution:** decreased dosage and more frequent monitoring are advised in patients with renal insufficiency.
- Arterial pH and osmolality may cause transcellular potassium shifts.
- More aggressive potassium repletion may be required for symptomatic hypokalemia and hypokalemia induced arrhythmias.
- Concentration of replacement KCl solution is 20 mEq KCl/100 ml sterile water.
- Recommended infusion rate is **10 mEq/hr**. Cardiac monitoring is **mandatory** for infusion rates > 20 mEq/hr and these rates should only continue for a short period of time.
- Monitoring: Serum chem 7, magnesium, ECG.
- Oral doses of greater than 40 mEq per dose are frequently not tolerated due to GI irritation.
- Extended release tablets (K-Dur®) will have a delayed onset of action. Potassium liquid is recommended for use if a more rapid enteral absorption is wanted.
- Rule out and treat hypomagnesemia with any state of hypokalemia.

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INTRAVENOUS MAGNESIUM REPLACEMENT RECOMMENDATIONS

Serum Mg (mEq/L)	Dose (no faster than 1g/hr)
1.3 - 2 (if desired Mg is > 2 mEq/L)	2 grams
0.8 - 1.2	4 grams
< 0.8	See recommendations for aggressive magnesium replacement

- 1 gram of Magnesium Sulfate = 98 mg elemental Mg = 4 mmol = 8 mEq
- The desired dose of Magnesium Sulfate should be mixed in 100 ml of 0.9% NaCl or D5W.
- Rates faster than 8 mEq/hr exceed the renal threshold and will result in excessive elimination of magnesium.
- Recheck serum magnesium with a.m. labs and continue to replete as needed.
- See Cautions and Monitoring below.

AGGRESSIVE MAGNESIUM REPLACEMENT THERAPY (For patients with serum Magnesium < 0.8 mEq/L AND symptomatic)

- 2g (16 mEq) Magnesium Sulfate over 10 minutes intravenously initially then:
- Continuous infusion of Magnesium Sulfate at 0.5g/hr intravenously for 72 hours
OR 1 - 2g intravenously every 4 hours for 72 hours.
- Check magnesium level every 6 hours and adjust for high circulating levels. It takes approximately 36 to 48 hours for magnesium to redistribute; therefore, when administering aggressive therapy higher levels may be seen initially. Keep serum Mg levels less than 2.5 mEq/L.
- If oral maintenance therapy is required, the recommended dose is 0.4 mEq/kg/day. Magnesium oxide 400 mg tablets are available. Each tablet is equivalent to approximately 20 mEq of magnesium.

SUDDEN EMERGENCIES

- Torsades de Pointes** – 2g Magnesium Sulfate IV over 1 to 2 minutes
- Seizures** – 2g Magnesium Sulfate over 10 minutes

- Cellular repletion of magnesium is slow and requires sustained correction over 3 to 5 days.
- Caution is advised in patients with:
 - **Renal Insufficiency:** Dosages should be decreased by 50% in patients with SCr > 2.5 mg/dL. Monitor Mg levels frequently.
 - **Atrioventricular block of severe grades or bifascicular block**
- **Monitor:** Serum magnesium, calcium, potassium and creat; DTR; Neurologic status; B/P.
- **These guidelines are not applicable for treatment of severe preeclampsia or eclampsia.**

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